Mineral Development in Ontario North of 50°

Technical Paper #9

Lead

Dr. H. Strauss
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Dr. E. T. Willauer

the ROYAL COMMISSION on the NORTHERN ENVIRONMENT

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LAURENTIAN UNIVERSITY

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However, no opinions, positions or recommendations expressed herein should be attributed to the Commission; they are solely those of the authors.

LEAD

INTRODUCTION

The purpose of the following discussion is to demonstrate that the future of the Canadian lead mining industry is assured mainly on the base of the large ore reserves of this country. However, due to a number of events, that future performance will not be as bright as it otherwise would have been and it would take considerable time and efforts to change the future course of development, especially since the world lead market is influenced by decisions largely beyond our control as most of them are made outside our borders.

This discussion is organized in the following way: Section I presents the metal 'lead' in its properties, qualities, occurrence and in its usefulness as well as substitutes. The second section analyzes the world demand for lead and investigates its industrial consumption pattern in the U.S.A. The world production of mined lead is studied in Section III, which also displays Canada's and Ontario's production and foreign trade position in that field. The reserves of the world and the activities of competing countries as alternative suppliers are carefully examined in Section IV, while the fifth and last section focusses on future lead prices and production as ascertained by the

econometric analysis. An appendix attempts to shed some light on the industrial and mineral policies in three important industrial countries with the aim to explain why the position of the U.S.A., as a world lead producer, has deteriorated so dramatically, a point which holds for a number of other metals as well.

SECTION I: THE METAL

Lead is one of the heaviest of all common metals which, when molten, cast or newly cut is of a silvery bright shine. In its normal oxydized state, it is dull blue-gray.[1] Besides being pliable and inelastic, its outstanding properties are: when exposed to the atmosphere, it becomes quickly covered with an insoluble and protective oxide or sulphate layer; it is the softest and the most corrosion resistant of the common, non-ferrous metals; it alloys easily with other metals such as tin and antimony; its chemical properties are such that a very large portion of its application is through its chemical compounds in gasoline as antiknock additives, in oxides as substances in batteries and in glassmaking, paints, colours and ceramics. A use which may increase in importance is its protective capabilities against radiation.

Lead has a number of substitutes. Plastics may find increased usage in building construction, as electric cable coverings, and in cans and containers. In the battery field, lead is in competition with zinc-nickel, nickel-iron, zinc-chlorine and lithium-sulfur batteries which are being developed as we move towards the more extensive use of electric vehicles. In addition, catalytic converters displace lead in its capacity as a gasoline additive.

In general, lead occurs in nature in the form of a mineral called galena in complex ore association with zinc and silver. Other ores such as copper and gold are also mined with lead as a by-product depending on the type and grade of the mineral deposit.

Lead is found and mined scattered throughout the world. Fifty countries in all produce lead, though some countries are more important than others. The main lead regions in the world are: North America, Australia, parts of South America, the U.S.S.R., Southeastern Europe and China.[2]

SECTION II: CONSUMPTION

World Consumption

Total Consumption

The consumption of primary refined lead for the period under study displayed a rise from 1,340,000 metric tons in the year 1950, to 4,344,000 metric tons in the year 1973. This means that consumption more than tripled over this timespan. This is shown in Table 1. In the years following 1973, consumption declined to 3,634,000 metric tons in 1975 and it stood at 3,926,000 metric tons in 1979. This topping-off of the lead consumption trend and the subsequent decline was mainly the result of a reduction of lead used in the automotive industry and of the greater availability of secondary lead as final lead demand declined. Considering that the consumption of primary and secondary lead amounted to 1,743,900 metric tons in 1950 and 5,136,000 metric tons in 1979, it is obvious that the availability of secondary lead negatively affected both primary lead and mine producers.

As Table 1 indicates, the ratio of ore to primary production showed a decline from a ratio of above 1.0 in the 1950s to between 0.78 and 0.91 after the year 1973. When relating lead ore (metal content) mined to final consumption of primary

Table 1

World Refined Lead Consumption (Primary) and the ratio of Ore Production to Refined Consumption for the Years 1950-1979

Year	Consumption in '000 metric tons	Ore Production / Refined Lead Consumption (Primary) %
1950	1340.39	114.89
1951	1648.93	93.39
1952	1594.04	103.51
1953	1751.52	114.76
1954	1983.68	94.77
1955	2106.29	92.58
1956	2066.96	95.79
1957	2126.48	96.40
1958	2149.61	91.64
1959	2226.81	86.22
1960	2271.72	106.97
1961	2477.93	97.66
1962	2578.53	98.51
1963	2656.83	95.60
1964	2783.29	92.34
1965	2794.54	98.40
1966	2935.70	97.42
1967	3020.98	96.00
1968	3158.96	94.97
1969	3448.00	94.55
1970	3542.07	96.55
1971	3588.52	94.75
1972	3723.51	92.65
1973	4343.59	78.28
1974	4163.15	81.91
1975	3634.25	93.83
1976	4026.42	82.70
1977	3882.73	84.22
1978	3770.98	94.01
1979	3925.96	91.67

and secondary lead, the picture becomes even more discouraging for the lead mining business.[3] In the year 1950, the world had to rely on the mining of lead by 88.3 percent, whereas in 1979, this reliance had declined to 70 percent as more and more lead was recycled.[4] This depressing condition for the lead mining industry could theoretically only be overcome if the consumption of lead would increase at a rate faster than recyclable lead becomes available from the ever-increasing stock of lead in use.

Distribution

Unquestionably, the United States of America has been and still is the main user of lead in the world. This is brought out in Table 2, which presents a survey over the consumption of primary and secondary lead for the years 1950 and 1979 by the main consuming countries. The United States, which in the year 1950 used 46 percent of the world's lead, consumed only 25.4 percent in 1979. This does not mean that its consumption decreased in absolute terms, but that its increase did not keep pace with that of the world as a whole, which rose by 194.5 percent, i.e. it almost tripled.

The United Kingdom is another country which bears a similar testimony. Its world consumption role diminished from 9.5 percent to 6.4 percent. Australia, Austria, Belgium, Czechoslovakia,

Table 2

Refined Lead Consumption (primary and secondary) of the World in metric tons and Distribution by Country for the Years 1950 and 1979[1]

	1950		1979	
Total Consumption	1.743,910.5		5,136,022.0	
Country	percentage		percentage	
United States	46.0		25.4	
Canada	2.8		2.1	
Mexico	0.6		2.4	
Argentina	2.0		0.6	
Brazil	1.1		1.6	
Other America	0.5		0.6	including Peru 0.2
Austria	0.5		0.9	
Belgium	2.9		1.0	
Czechoslovakia	1.4		1.1	
Denmark	0.6		0.5	
France	3.4		4.1	
Germany-West	5.8		6.2	
Italy	2.5		4.7	
Netherlands	1.5		1.1	
Spain	1.1		2.2	
Sweden	1.6		0.3	
Switzerland	1.1		0.1	
United Kingdom	9.5		6.4	
Yugoslavia	0.4		1.6	
Other Europe	1.2		0.004	
India	0.9		0.9	
Japan	1.4		5.2	
Other Asia	0.2		1.8	(excluding N. Korea)
China	(incl. other Asia)		41.	
Africa	0.5		1.6	
Australia & New Zealand	2.9	Australasia	1.6	

cont'd...

	1950	1979
	%	%
Poland	1.5	1.9
U.S.S.R.	6.4	12.5
Other Europe	1.2[2]	0.004
Finland	(O.E.)	0.3
Greece	(O.E.)	0.5
Ireland	(O.E.)	0.05
Norway	(O.E.)	0.3
Portugal	(O.E.)	0.2
Albania	(O.E.)	0.05
Bulgaria	(O.E.)	2.0
Germany DR	(O.E.)	1.9
Hungary	(O.E.)	0.3
Rumania	(O.E.)	0.9
Turkey	( )	0.2

Source: ABMS, Non-ferrous Metal Data, 1979, New York, N.Y., p. 47; and the 1950 edition and corresponding publication by ABMS, p. 37.

[1]These values may differ from the estimates quoted by John A. Wright, "Lead, Tight Supplies and Continuing Demand Elevate U.S. producers and LME Prices," Engineering and Mining Journal, March 1980, p. 81.

[2]O.E. means included under other Europe in 1950.

the Netherlands, Switzerland, Sweden and Argentina belong in the same category, whereby the industrial consumption of lead declined in absolute terms for the last three.

Canada's position as a world consumer has likewise declined in relative but not in absolute terms. As a matter of fact, this decline is less severe than that of the United States. Canada moved from a 2.8 percent position in 1950 to 2.1 percent in 1979. When compared to the United States the comparative factor of decline was 0.55 for Canada to 1.0 for the United States.

In contrast, several countries stand out in the way in which they improved their lead consumption performance. On the top of the list is the Soviet Union. From a mere 6.4 percent of consumption, it moved to almost double that amount. The same holds for Poland and most probably also for Bulgaria and Eastern Germany, countries for which the comparative values for the year 1950 are not available in the sources consulted. Evidently, these are the industrially powerful nations of the 'centrally planned' economies.

Yugoslavia and Mexico are likewise very impressive users of lead. From the relatively insignificant world shares of 0.4 and 0.6 of one percent for Yugoslavia and Mexico respectively, they succeeded in holding 1.6 and 2.4 percent respectively in

the year 1979. This implies a fourfold increase in world consumption shares or an increase of eight times each over their levels of 1950.

The industrial giants of Europe and Asia also hold very strong positions as lead consumers. In Europe, Italy, France and the Federal Republic of Germany were able to raise their already significant shares of the year 1950 even further. Spain, although not as strong an industrial nation as the other three, similarly enlarged its lead consumption, bringing it to double the rate than that of the world as a whole.

In Asia, it is, of course, the industrial colossus of Japan which displayed the most outstanding performance. From a mere 1.4 percent, it rose to 5.2 percent which corresponds to an absolute increase in lead consumption by a factor of eight. This fact does not require any further comment.

Therefore, the main industrialized countries of the world and those in the process of developing a strong industrial capacity are consuming lead at a rate higher than the rest of the world. The contrast is the United States, which is at the pinnacle of industrialization. It is the world's largest lead consumer but no longer displays any comparable surge in consumption. The attention shall now focus on the pattern of consumption in the United States.

Industrial Lead Consumption in the United States

As previously indicated, the consumption of lead in the United States did not show any permanently rising trend between the years 1976 and 1979. There may have been an increase if one compares the years 1975 and 1977, but the general impression is that the overall level of lead consumption has remained relatively stable.

There are two main types of uses of lead: metal products and non-metal products consisting of pigments and chemicals. If one subtracts from the consumption in 1978 and 1979 the amount of undistributed consumption, then the figure for the metal component of lead consumption would be slightly above 71 percent. This means that between 72 and 75 percent of lead is used in metal form, while the remainder of non-metallic variety is shared by one quarter through lead pigments and three quarters through lead chemicals. The lion's share of the latter is in the form of lead additives. This composition is given in Table 3.

Considering that between 55 and 60 percent of lead used in the United States goes into lead batteries and that another 14-16 percent is absorbed as lead additives in gasoline, then it must be quite apparent that the lead consumption in the automotive and equipment field accounts for almost 75 percent of the total.

Table 3

Lead Consumption in the U.S.A.

Total Consumption in metric tons and percentage Distribution by Type of Use

for the Years (1975) 1976-1979

		1975	1976	1977	1978	1979
	Total Use (metric)	1,176,727	1,351,793	1,435,497	1,432,765	1,303,919
	Metal Products					
1	Ammunition		4.93	4.32	4.25	4.06
2	Bearing metals		0.88	0.76	0.61	0.60
3	Brass and bronze		1.05	1.06	1.09	1.19
4	Cable covering		1.07	0.95	1.00	1.20
5	Calking lead		0.84	0.61	0.44	0.31
6	Casting metals		0.45	0.38	0.08	0.72
7	Collapsible tubes		0.16	0.13	0.09	2)
8	Foil		0.34	0.23	0.39	2)
9	Pipes, traps and bends		0.93	0.74	0.48	0.23
10	Sheet lead		1.64	1.06	0.46	0.50
11	Solder		4.25	4.06	3.32	3.10
12	Storage batteries		25.76	29.03	24.62	23.76
13	Storage batteries (oxydes)		29.43	30.75	27.64	25.88
14	Terne metal		0.11	0.10	0.29	0.36
15	Type metal		1.01	0.79	0.52	0.60
16	Total metal products	76.17	72.85	74.96	65.28	63.16

cont'd....

Table 3 cont'd.

		1975	1976	1977	1978	1979
	Pigments (total)		6.9	6.3	6.25	6.35
17	White lead		0.02	0.41	0.87	inadequately
18	Red lead and litharge		5.73	4.93	4.39	specified
19	Pigment colours		1.12	0.92	0.97	3)
20	Other pigments		0.03	0.04	0.03	
	Chemicals					
22	Gas, anti-knock additives		16.10	14.72	13.28	14.34
23	Other chemicals		0.01	-	-	1.23
	miscellaneous uses					
24	Annealing		0.19	0.17	0.10	
25	Galvanizing		0.08	0.09	0.09	
26	Lead plating		0.03	0.03	0.02	.60 2)
27	Weights and balast		1.50	1.21	0.54	
28	Unclassified		2.17	2.49	14.41	14.92 1)
	Non-metal Total 4)		26.98	25.01	34.70	37.44

Source: American Metal Market, Metal Statistics, 1979. New York, N.Y., p. 123. For 1979, see note 3, infra.

1) includes undistributed consumption

2) lead consumed in foil, collapsible tubes and items 24-27

3) as based on ABMS, Non-ferrous Metal Data, 1979, New York, N.Y., p. 53.

4) data may not add up to total due to rounding

If this is the most important application of lead in the most industrialized country of the world, it stands to reason that the increasing pace of lead consumption by the various countries mentioned above is indicative that they are on a course towards an ever-increasing industrial production and subsequent stock of automotive vehicles and equipment where lead is necessary in the generation of power. Lead is, therefore, essential not only in the field of private automobiles such as passenger cars, but also in all forms of trucks and for all military vehicles!

If one also bears in mind that red lead and litharge pigments are still the most effective ingredients in rust-protective paints - especially for ships, structures such as bridges and heavy equipment - then, the total of lead used in this field of motor vehicles and equipment could account for almost 80 percent of actual industrial consumption. This percentage of lead used in the motor vehicle and equipment field is bound to increase if the electro-vehicle should eventually break into the market.

Of the other uses of lead as a metal, perhaps ammunition, solder and sheet lead should be mentioned here. Evidently, these three types of use are of minor significance compared to the main component of automotive applications. Furthermore, the use of lead in brass and bronze as well as in cable

coverings do not display any significant amount compared to the other metal uses of lead. It is clear that substitutes of the plastic variety are making inroads into this field.

It follows, therefore, that as the world is engaged in a big industrial leap forward, especially by the under-developed countries, that the consumption of lead on a world-wide basis must continue to expand in the years ahead. At the same time, however, it should be realized that this expanded consumption of lead will increasingly draw on secondary, recycled lead rather than on newly mined ores.

SECTION III: WORLD MINE PRODUCTION OF LEAD

World, Canada, Ontario

World lead ore output more than doubled between 1950 and 1979 as the quantity of mined lead rose from 1,540,000 metric tons in the year 1950 to 3,450,000 metric tons in 1972. Having reached this major peak, lead output levelled off to a low of 3,270,000 metric tons in 1977, after which year it rose to almost 3,600,000 metric tons in 1979. In this fashion, it continued the previous upward trend. In essence, the lead mining output paralleled a similar performance on the consumption side.

Canada, in turn, followed a similar pattern of lead ore production. From 150,300 metric tons brought to the surface in the year 1950, output slowly rose until the year 1972, when 377,000 metric tons of lead were mined. From then on, it declined until the year 1976 to a volume of 256,300 metric tons, only to move up slightly in the final years of the 1970s. This means that between 1972 and 1976, world output declined by 120,000 metric tons, while that of Canada during the same period sank by 120,800 metric tons. This is a reflection of the high sensitivity of Canadian lead production to what happens to the demand side of the whole world. However, as world lead

mine production recovered between 1977 and 1979 by a considerable amount of 329,000 metric tons, the Canadian output advanced only by 31,600 metric tons. This means that we absorbed the shock for the world as a whole and when things started to improve, the Canadian lead mining industry was left behind!!

Therefore, Canada appears highly vulnerable in the area of lead mining. This is due to the fact that other countries import lead ores and concentrates only if they cannot avoid it due to a lack of domestic mineral resources and secondary lead. This vulnerability has become more obvious in the more recent years than earlier in the period under investigation.

Nonetheless, the Canadian position as a world lead ore producer has fluctuated between 6.84 percent of the world total in the recession year of 1961, when the country absorbed a lull in the world demand for mined lead and 10.93 percent in 1972, the year of the mid-1970 peak of world lead output. In short, Canada has been and still is a very important world lead supplier as it succeeded to keep pace with the other world competitors!

The role of Ontario is also clear in this respect, although not very positive. Table 4 presents the picture where Ontario's role in the field of lead ore production is conspicuous through nothing but its absence.[5] Unless significant ore bodies are discovered and opened up, this position is unlikely to change. That is all that can be said at this particular point.

Table 4

World and Canadian Production of Lead Ore in '000 metric tons

and Canada's and Ontario's Role as World Lead Producers

(percentage of production share) for the Years 1950-1979

Year	Production		Share in World Lead Output (%)	
	World	Canada	Canada	Ontario
1950	1540.00	150.3	9.76	0.00
1951	1540.00	143.5	9.32	0.00
1952	1650.00	153.2	9.28	0.05
1953	2010.00	175.7	8.74	0.01
1954	1880.00	198.2	10.54	0.06
1955	1950.00	183.9	9.43	0.09
1956	1980.00	171.3	8.65	0.07
1957	2050.00	164.6	8.03	0.02
1958	1970.00	169.4	8.60	0.07
1959	1920.00	169.4	8.82	0.04
1960	2430.00	192.5	7.92	0.03
1961	2420.00	165.6	6.84	0.10
1962	2540.00	191.7	7.55	0.04
1963	2540.00	180.5	7.11	0.05
1964	2570.00	187.2	7.28	0.07
1965	2750.00	274.8	9.99	0.06
1966	2860.00	293.2	10.25	0.07
1967	2900.00	308.2	10.63	0.18
1968	3000.00	327.6	10.92	0.41
1969	3260.00	300.1	9.21	0.35
1970	3420.00	357.9	10.46	0.32
1971	3400.00	367.9	10.82	0.24
1972	3450.00	377.1	10.93	0.31
1973	3400.00	342.0	10.06	0.31
1974	3410.00	294.3	8.63	0.27
1975	3410.00	349.1	10.24	0.18
1976	3330.00	256.3	7.70	0.21
1977	3270.00	284.1	8.69	0.25
1978	3545.19	319.7	9.02	0.19
1979	3599.02	315.7	8.77	0.24

World Producers and Capacities

As the world production of mined lead rose from 1.6 million metric tons to roughly 3.6 million metric tons over the years 1950 to 1979, the relative positions of some of the main producers underwent substantial changes. At first, the attention should be directed towards the United States. In 1950, it held 23.7 percent of world lead output, which was reduced to somewhat above the 14 percent level in 1979. This is a very significant change in the downward direction, considering that it also was the largest consumer of the world.

In contrast, the Soviet Union has increased its share from a significant 6.4 percent to become the world's largest lead producer with about 16 to 17 percent. This means its rate of expansion has been two and a half times faster than that of the world as a whole!

The second largest lead producer in the year 1950 was Mexico. It held 14.5 percent of the world total which rapidly decreased to a mere 4.8 percent. This is an even more dramatic relative decline than that experienced by the U.S.A. Third and fourth places on the world lead ore scene are held by Australia and Canada. Both Australia's and Canada's standings were slightly reduced from 13.6 to 11.9 and from 9.1 to 8.8 percent respectively. This decline took place mainly over the 1970s. Another six countries are producers which hold smaller but still greatly

Table 5

World Production of Lead Ore and Percentage Distribution by Main Producing Countries for Selected Years between 1950 and 1979

Year	1950	1955	1960	1965	1970	1975	1979
World Production ('000 metric tons)	1646	2181	2430	2750	3420	3410	3599
Country							
Australia	13.6	13.8	12.9	13.4	13.4	12.2	11.9
Bulgaria	-x)	2.4	3.9	3.6	2.9	3.3	3.2
Canada	9.1	8.4	7.9	10.0	10.5	10.2	8.8
China	-	-	3.3	3.6	2.9	2.9	4.2
Iran	-	-	0.6	0.4	0.7	1.6	0.8
Japan	0.7	1.2	1.6	2.0	1.9	1.5	1.3
Korea (N)	-	-	2.1	2.2	2.0	3.5	2.9
Mexico	14.5	9.7	7.8	6.2	5.2	4.8	4.8
Morocco	2.9	4.1	3.9	2.8	2.5	2.0	3.0
Peru	3.9	5.4	6.8	7.1	4.8	5.3	5.1
Poland	-	1.7	1.6	1.7	2.0	1.9	1.4
Spain	2.4	2.9	3.0	2.1	2.1	1.7	2.0
Sweden	1.4	1.5	2.3	2.5	2.3	2.1	2.3
U.S.S.R.	6.4$\overset{x}{x}$)	10.1$\overset{x}{x}$)	13.2	12.7	12.9	(13.2	16.7)o)
U.S.A.	23.7	14.1	9.2	9.9	15.2	16.5	14.4
Yugoslavia	4.8	4.1	3.8	3.9	3.7	3.7	3.6
	83.4	79.4	83.9	84.1	85.0	86.4	86.4

Source:

x) blanks mean: not recorded with the U.N.

$\overset{x}{x}$) estimated

o) the increased % (for 1979 over 1975) for the U.S.S.R. results from differences in the statistical base of the U.N. statistics and those of the ABMS, Non-ferrous Metal Data, 1979, New York, N.Y., p. 45.

impressive shares of the world totals for the year 1979. They are China (4.2%), Peru (5.1%), Yugoslavia (3.6%) and Bulgaria (3.2%). They are followed by North Korea, Morocco, Sweden, Spain, Poland, Japan and Iran. Five of these had not been recorded as producers in the year 1950 by the United Nations. Most of these countries have stepped up their lead mining operations significantly with the exception of Spain and Sweden which both maintained their earlier positions.

Smelter and Refinery Capacity

It is, of course, of interest to observe the dramatic decline in smelter and refinery capacities of some of the producing countries. The attention here focusses on the United States, Canada and Mexico on the one side, displaying a severe decline in this respect, and on those on the other side, which excel through rising smelting and refinery capacities. The years for comparison are 1950 and 1979.

The events on the North American continent are reflected in Table 6. The three main producing countries are the United States of America, Canada and Mexico. They geared down their smelting and refining capacities substantially. By the year 1979, the smelting and refining capacities for the U.S.A. had decreased by 33.8 and 9.4 percent respectively. Canada had cut down on its smelting capacity by 25 percent while the refining capacity

Table 6

Lead-Silver Smelter and Refinery Capacity North America Only for the Years 1950 and 1979 (metric tons)

	Smelter Capacity			Refinery Capacity		
Country	1950	1979	Δ and %Δ	1950	1979	Δ and %Δ
U.S.A.	1685578	1115856	-569722 -33.8%	785635	712152	-73483 -9.4%
Canada	635040	476280	-158760 -25%	226800	222264	-4536 -2%
Mexico	1088640	807862	-280778 -25.8%	293933	244944	-48989 -16.7%

Source: ABMS, Non-ferrous Metal Data, 1979, and ABMS, Yearbook, 1951(1950), New York, N.Y.

went down by 2 percent. Mexico lost 25.8 percent in smelting and 16.7 percent in refining capacity over the same period.

This means that the North American smelter capacity decreased from 3.4 million metric tons in 1950 to 2.4 million metric tons in 1979, or by a total of -29.6 percent. Similarly, the refining capacity for the area was cut down from 1.3 million metric tons in 1950 to 1.18 million metric tons, or by a rate of -9.5 percent over the same period.

When examining the other lead refining countries (Table 7), there are only three which likewise lost in smelting and refining potential. They are Spain (-47.2%), Burma (-41%), and, to a smaller degree, Tunisia (-3%). All others, and this includes, of course, secondary refining works, have shown increases. Some of these are highly spectacular as, for instance, Brazil, Belgium, Greece, Sweden, the United Kingdom, Japan and Yugoslavia. They all more than doubled their smelting and refining potential. Japan raised its metal working capability by 437.6 percent from 46,500 metric tons in 1950 to 250,000 metric tons in 1979.

Other countries have shown less significant though still quite impressive improvements in their refining and smelting abilities. They are Argentina, Peru, Austria, West Germany, Zambia and Australia. For others, such as Czechoslovakia, Poland and Romania, comparable statistics are not available in the sources consulted. The same holds for the U.S.S.R. which will be discussed further below.[6]

Table 7

Refined Lead Capacity

Lead Smelter and Refinery Works

World Data in metric tons

	1950	1979	Δ%
Argentina	18000	31500 +	75
Brazil	9000	58000 +	544
Peru	40000	90000 +	125
Austria	12000	16000 +	33
Belgium	127700	135000 +	387
France	106700	225000 +	111
West Germany	221000	262000 +	18.6
Greece	3000	30000 +	900
Italy	66000	68000 +	3
Netherlands	n.a.	45000 (+)	
Spain	185500	126000 -	(-)47.2
Sweden	24500	60000 +	145
U.K.	125200	350000 +	179.6
Yugoslavia	40000	75000 +	87.5
India	n.a.	18000 (+)	
Japan	46500	250000 +	437.6
Burma	93000	66000 -	-41
Morocco	n.a.	35000 (+)	n.a.
Tunisia	30900	30000 -	-3
Zambia	18000	24700 +	37.2
Australia	223500	257600 +	15.3
Namibia	n.a.	75000 (+)	
Czechoslovakia	5500	n.a.[1]	
Poland	57800	n.a.[1]	
Romania	8300	n.a.[1]	
	1462100		

Source: ABMS, Non-ferrous Metal Data, 1979, and

[1] no comparable data available

In summary, North America has lost 'precious' smelting and refining potential whereas the main industrial consumers of the world have invested heavily in the smelting and refining of lead regardless of whether or not they have sufficient ore.

Canada's Foreign Trade in Lead

Disregarding the production of secondary smelter and refinery lead, a very interesting situation exists when the total of our lead mine production is compared to the trade in lead products. The following breakdown brings out the salient point.

	'000 metric tons		
Year	Mine Output	Exports	Imports
1977	284.1	292	3.3
1978	319.7	301	4.0
1979	315.7	301	2.6
	919.7	894	9.9

When adding each separate item for the three years, our net exports of lead amounted to 96.2 percent of our mining output, and only 3.8 percent remained in Canada on a net basis. This is an extraordinarily large export dependence which may work very well for the interest of the mining industry and the economy of the country. However, it underscores the vulnerability of the Canadian lead mining industry to external, negative disturbances.

Table 8

Canadian Lead Export and Import Structure for the Years 1977-1979 by Commodity Items

Quantities in Metric Tons and Percentage Distribution

Commodity Item		Export 1979	Export 1978	Export 1977	Import 1979	Import 1978	Import 1977
	Volume	300,996	300,960	292,142	2,633	3,985	3,326
		%	%	%	%	%	%
254-10	Lead in Ores and Concentrates	50.33	47.40	47.08	-	-	-
254-39	Lead and Lead Alloy Scrap and Dross	7.26	5.85	5.46	-	-	-
453-09	Lead Pigs, Blocks and Shot	39.20	43.84	44.78	81.01	43.04	24.68
453-49	Lead Fabricated Materials n.e.s.	3.21	2.91	2.68	18.99	56.96	75.32

Obviously, the lead imports are almost insignificant. On the export side, 50 percent of our lead exports are in the form of ores and concentrates, while 39 percent are taken up by lead pigs, blocks and shot. This was the situation in the year 1979. During the two previous years, a smaller percentage was exported in terms of ores and concentrates. In turn, significantly larger amounts of refined lead metal were shipped abroad.

Japan was our most important customer, taking 63 percent of our ores and concentrates, at least for the three years under discussion.

The United States was the second most important importer of our lead ores while Western Germany was third in that sequence of importance.

It was also observed that the Soviet Union has become a relatively important customer, purchasing 7 percent of our exported lead ores and concentrates in the year 1979. In 1978, this item counted only for 1 percent. This is shown in Table 9, which also tries to point out the increased value of shipment due to higher lead prices on world markets.

From $48 million in 1977, it rose to $109.3 million in 1979. In 1978, this item counted only 1 percent, as shown in Table 9.

The export of lead and lead alloy scrap and dross recorded a marked increase in both volume and value. Here, the main

Table 9

Lead in Ores and Concentrates (commodity 254-10)

for the Years 1977 to 1979

	Quantity (MT)			Value $'000		
	Export	Import	Balance	Export	Import	Balance
1979	151,487			109,771		
1978	142,641			52,518		
1977	137,541			48,034		

Export	1977 -	Japan	63% of total quantity
		U.S.	13% of total quantity
		West Germany	12% of total quantity
	1978 -	Japan	63% of total quantity
		U.S.	16% of total quantity
		West Germany	10% of total quantity
	1979 -	Japan	48% of total quantity
		U.S.	24% of total quantity
		West Germany	13% of total quantity

In 1977, the U.S.S.R: 0.0%

In 1978 the U.S.S.R. got 1% and in 1979, 7%

customers were alternately the United States and Western Germany, followed by the Republic of South Africa (1979), Sweden (1978) and Japan (1979). There are, of course, other countries which import these commodities from Canada, but they are not large enough to alter the overall picture of significance (Table 10).

Table 11 presents Canadian exports and imports of basic refined leads. This table displays a very favourable export balance in terms of both quantities and values of shipment. Unquestionably, the United States have been the chief importers of this category of lead products, followed in all three years by the United Kingdom. In the year 1979, Italy purchased a significant amount of such lead types, while even the Soviet Union bought a total of 4 percent of these exports. The financial balance was better in all years compared to the balance of the ores and concentrates items of Table 9. These receipts were larger even if the quantity had decreased; but value-added per unit had gone up. This demonstrates the impact of refining on value received and why it pays to ship refined metals instead of ores and concentrates. In turn, the increase in volume of ores and concentrates states the preferences of our customers.

Our small imports of these types of lead came almost exclusively from the United States. They were utterly unimportant to affect the overall picture.

Table 10

Lead and Lead Alloy Scrap, Dross, Etc. (Commodity 254-39)

for the Years 1977 to 1979

	Quantity (MT)			Value $'000		
	Export	Import	Balance	Export	Import	Balance
1979	21,864			13,411		
1978	17,606			7,074		
1977	15,964			5,315		

Export	1977 -	West Germany	33% of total quantity
		U.S.A.	17% of total quantity
		South Africa	14% of total quantity
	1978 -	U.S.A.	27% of total quantity
		Sweden	20% of total quantity
		Japan	17% of total quantity
	1979 -	West Germany	27% of total quantity
		U.S.A.	26% of total quantity
		Sweden	19% of total quantity

Table 11

Lead Pigs, Blocks and Shot Exports and Imports

(commodity 453-09) for the Years 1977 to 1979

	Quantity (MT)			Value $'000		
	Export	Import	Balance	Export	Import	Balance
1979	117,994	2,133	115,861	142,734	2,655	140,079
1978	131,955	1,715	130,240	94,885	1,413	93,472
1977	130,821	821	130,000	79,521	575	78,946

Export 1977 - U.S.A. 51% of total quantity

U.S. 31% of total quantity

1978 - U.S.A. 50% of total quantity

U.K. 29% of total quantity

In 1977 - 0
1979 - 0 not in order of size

U.S.S.R. 4% of total quantity

1979 - U.S.A. 52% of total quantity

U.K. 32% of total quantity

Italy 6% of total quantity

Import 1977 - U.S.A. 99.9% of total quantity

1978 - U.S.A. 99% of total quantity

1979 - U.S.A. 99.9% of total quantity

The last of these foreign trade items are listed in Table 12, showing exports and imports of lead fabricated material not elsewhere specified. With a favourable balance of $11.1 million in 1979 and 9,151 metric tons more exported than imported, the lead export-import structure reveals its main last item. This is very much on the positive side of the ledger, especially since there has been a substantial improvement over the previous two years.

The resulting overall lead export and import balance for these years showed a current account (merchandise) surplus of

$274.412 million in 1979,

$157.650 million in 1978, and

$135.052 million in 1977.

This means that, expressed in Canadian currency, between 1977 and 1979, this balance more than doubled in Canada's favour.

Table 12

Canadian Lead Fabricated Materials NES Exported and Imported (commodity 453-49) for the Years 1977 to 1979

	Quantity (MT)			Value $'000		
	Export	Import	Balance	Export	Import	Balance
1979	9,651	500	9,151	12,043	892	11,151
1978	8,758	2,270	6,488	7,606	3,020	4,586
1977	7,816	2,505	5,311	5,823	3,066	2,757

Export	1977 -	U.S.A.	95% of total quantity
		Sweden	3% of total quantity
	1978 -	U.S.A.	96% of total quantity
		U.K.	2% of total quantity
	1979 -	U.S.A.	90% of total quantity
		U.K.	8% of total quantity
Import	1977 -	U.S.A.	96% of total quantity
		U.K.	1% of total quantity
	1978 -	U.S.A.	95% of total quantity
		West Germany	4% of total quantity
	1979 -	U.S.A.	95% of total quantity

SECTION IV: RESERVES AND ALTERNATIVE SUPPLIERS

This section investigates two areas of interest. At first, it will attempt a general view over the distribution of the lead ore reserves throughout the world. An interesting picture will be presented although, naturally, the most recent information concerning new discoveries and any estimates of yet unknown reserves beyond what has been included are not part of the appraisal. The purpose is mainly to give a general view of the distribution. Secondly, the attention will be directed towards the lead activities of the main lead mining countries to assess the general direction into which these producers are heading. Likewise, the analysis does not claim to be complete. Yet, it provides important insight into the path of development of the lead industry in different parts of the world.

World Lead Reserves

By 1975 standards, the world lead resources, excluding speculative and otherwise then undiscovered and uneconomic resources, amounted to 300 million metric tons of lead metal content. Of these, over 51 percent were located in North America with the United States as the world's largest storehouse of lead.

It counted 36 percent of the total as shown in Table 13.

Canada is the world's second largest resource holder with 11.8 percent, followed closely by the Soviet Union in third place. It accounts for about 10.9 percent. The region of Australasia is the fourth largest supplier with 9.0 percent. After these four chief lead reserve countries (or areas), about eight countries can be lined up which individually share between 3.0 and 1.8 percent of the total. They are Mexico and West Germany, both with 3.0 percent. Behind them are Peru (2.4%) and Bulgaria, China, Yugoslavia, Spain and Poland. Each has a stake of 1.8 percent in the world lead ore total. As that Table also demonstrates, there are other countries such as Sweden, Iran, Namibia and Algeria, which are all well-known lead ore suppliers, not counting the remainder of the over forty-six lead producing countries of the world as listed by the United Nations publications. In short, over 70 percent of the known lead ores are distributed over three major geographic entities. Fifty-one percent are in North America, 10.9 percent in the Soviet Union and 9.0 percent in Australasia. Canada has the second largest lead reservoir in the world.

Table 13

Lead Resources of the World & Percentage Distribution by Country

	%
U.S.A.	36.0
Canada	11.8
Mexico	3.0
Other North America	0.6
Peru	2.4
Other South America	1.2
West Germany	3.0
Bulgaria	1.8
Yugoslavia	1.8
Spain	1.8
Poland	1.8
Sweden	1.2
Other Europe	3.6
Morocco	0.9
Namibia	1.2
Algeria	0.9
Otehr Africa	1.2
U.S.S.R.	10.9
China	1.8
Iran	1.2
Other Asia	2.4
Oceania/Australia	9.0

Source: n.2, ibid., p. 596

Alternate Suppliers

This most essential non-ferrous metal in the service of men is drawn from two sources: ore and scrap. The interest of the following discussion centres on the alternate suppliers of lead in the world which Canada may face as competitors in the world market. According to the widely dispersed distribution of lead ore over this globe, the main resource holding countries will be investigated here. They are: The United States, the U.S.S.R., Australia, Peru, Mexico, China, Bolivia and Yugoslavia. However, one exception has been made at the end of this section, as one interesting point had to be mentioned throwing some light on a country that is not high on the list of reserve holders - East Germany.

Our main countries produce 66 percent of lead ore, or, in other words, eight countries supply that total out of between forty-six and fifty countries.[7] This means that there is a small number of countries which mine lead ore in small quantities which are not included. They have their ores custom-refined in other countries.[8]

The United States

There are over 30 lead mines in the United States, of which the 7 leaders produce 89 percent of annual output, while 25 mines account for about 99.0 percent. These 7 biggest mines are all located in the State of Missouri, the main lead mining

camp of the world. The other lead mining areas in the United States responsible for the remaining 11 percent are in Idaho, Montana and Colorado. A small amount is delivered by other states of the Union.

Furthermore, when examining the area of production after the ore has left the ground, it is interesting to notice that the primary smelters and refiners are located in Missouri, Idaho, Texas, Montana and Nebraska. In economic parlance, they are in a supply-oriented location. In contrast, the industrial cities of Philadelphia, Detroit, Cleveland, Chicago, Baton Rouge, Dallas, Los Angeles and San Francisco have the secondary lead smelters. These smelters are, therefore, in a market-oriented location.

Normally, ores are concentrated at the mine sites of the larger and most medium-sized mines.[9] As is well-known, the oldest and main lead mining camp is Missouri and only the more recent discovery of the Viburnum Trend in the West has added to the great known reserves of the U.S.A. as the greatest storehouse of lead in the world.

In the United States, the year 1979 apparently saw a consumption of 1,260,000 (versus a reported 1,350,000) metric tons of lead, of which 92,000 metric tons were imported. These imports came from the following countries:

Ores, Concentrates and Bullion	Percent	Country of Origin
	29	Honduras
	24	Peru
	17	Canada
	15	Australia
	15	Other
Pigs and Shot	32	Canada
	32	Mexico
	14	Peru
	5	Australia
	17	Other Countries

This breakdown shows that Canada plays a very important part in supplying the United States with the lead they consume. The primary refined production was about 570,000 metric tons and secondary production amounted to 760,000 tons. In essence, the United States had a net reliance of 8 percent on imports.

This means that the world's largest consumer of lead with the greatest resource potential was importing lead as its smelting and refining capacity decreased. However, a note of caution is in order lest we forget that a considerable quantity of the lead imported into the United States stems from external mine resources owned by United States corporations.[9]

On the investment side, no extraordinary projects are planned in the smelter and refinery area. The major new lead projects in the United States are in Montana where two new mines will be opened while an existing mine will be expanded. Asarco

is spending at least $77 million to bring the property at West Fork, Montana into production by the year 1984. St. Joe Mineral Corporation is investing $25 million on a mine in Bixby, Montana which will be on stream for the Viburnum mill by 1983. Ozark Lead is expanding its operations at Sweetwater, Montana by increasing the underground mining activities from 25,400 metric tons of concentrates to 87,100 metric tons by 1981; this is an increase by a factor of 2.4 for this mine. The combined tonnage of ore to be expected from these investments by Asarco and St. Joe Minerals will be about 1,770,000 metric tons per annum. In all other areas of the United States, "it is quiet at the leaden front!", certainly a surprising, if not disconcerting situation in which the United States finds itself.

The Soviet Union

	Lead Production	Lead Consumption
1950	106,000 metric tons	111,585 metric tons
1979	599,890 metric tons (ABMS)	640,030 metric tons

The U.S.S.R. is the second largest producer of lead in the world and it is in the process of taking up first place. Only 10 percent of final lead produced for industrial inputs is secondary lead. Between 1970 and 1978, the exports of lead from the U.S.S.R. increased from 92,400 tons to an estimated 95,000

tons, while the imports of this important metal rose from about 38,800 tons to 60,000 tons over the same period. Canada made its contribution in this area as pointed out above. This means that the U.S.S.R. is still a net exporter of lead (IMMR. p.182).

The sources of lead ores in the U.S.S.R. are Kazakhstan, which is the producer of lead (and zinc for that matter) followed by the Ural Mountain area, Siberia, Uzbekistan, the North Caucasus and the Ukraine. Unfortunately, an exact percentage distribution is not available from the sources consulted.[11] According to official plans, increases in output of lead (and zinc) in terms of both ores and refined metals can be attributed to the mining complexes at Leninogor, Zyryanov and Tekeli, plus the contributions coming from the completed first stage of the Kargayly Complex. General reports indicate that certain production plans in Kazakhstan were not fulfilled. This was supposed to be true in terms of quantity and quality of the output. Although news of such under-performances are taken as a confirmation that the planning system does not function, caution is indicated not to read too much into such comments. The point is that if things do not function that perfectly, then how does it come that this country seems to outproduce any other country in the production of almost all minerals?!

Evidently, there is no question that the U.S.S.R. being the consumer as it is, will need more lead. This lead will be obtained by both mining and imports. Already, it uses

100,000 metric tons of secondary lead annually. In addition, it is supplying other countries with refined lead. In this way, the Canadian lead ores and concentrates exported to the U.S.S.R. could easily find their way through U.S.S.R. re-exports to third countries, and that in refined form, at least for the time being.

Australia

The Australian lead industry is expanding its ore recovery at various mines. For the year 1983, an addition of 30,000 metric tons in smelting capacity to its present potential of 150,000 metric tons is expected to be operational for the MIM Holdings firm at the famous Mount Isa in Queensland. The cost of this expansion will be $55 million. It has to be mentioned that the Mount Isa area is the second most important mining camp after the Broken Hill district in New South Wales.

Furthermore, EZ Industries of Australasia Limited, decided to start the development of the Elura lead-zinc deposit near Cobar, also in New South Wales. This will be an open-pit mine which is planned to produce 1.1 million metric tons of ore per year. The investment will cost $180 million and it will be in operation in 1982. The reserves are 27 million metric tons with a lead grade of 5.6 percent, 8.3 percent zinc and 139 grams of silver per metric ton.

It is also contemplated to bring the McArthur silver zinc-lead deposit into operation which would become feasible if lead prices would climb sufficiently. At present prices, the project would not be viable. In short, Australia is expanding its lead production by opening new mines and the expansion of existing mines. In addition, the smelting and refining capacities are enlarged involving an expenditure of more than $235 million!

Peru

In Peru, Centromin is the largest producer of lead followed by Minera Atacocha and by Milpo, which is a medium-sized producer. All three are expanding their mining and plant capacities. However, additions to the existing 90,000 metric tons of smelting and refining capacities are highly unlikely.[12] This means that Peru will maintain its position as a medium-sized supplier of lead in the world.

Mexico

Mine Production

1950	238,100 metric tons
1979	172,510 metric tons

During the year 1979, no major new lead-zinc mine was put into operation. However, one major mine expansion came on stream at the Santa Eulalila Division of Industrial Minera Mexico (IMMSA).

It doubled the annual ore tonnage hauled from 125,000 tons to 250,000 tons of ore. Furthermore, the Naica mine of the Fresnillo Company has successfully penetrated to deeper levels. The same holds for the San Antonio mine and for the Charcas Division, both owned by IMMSA. It should also be mentioned that slight capacity increases occurred.

In the future, Industrial Minera Mexico - IMMSA - will increase its underground mining and concentrator capacity by 65 percent from 550,000 metric tons to 825,000 metric tons by 1981. The ore contains 4.2 percent zinc, 1.9 percent lead and 137 grams of silver per ton. Therefore, Mexico will be a country to be reckoned with as a competitor in the world market as that country will continue to produce lead (and zinc) in the general attempt of its mining industry to catch up with the territory it lost as a world producer over the last two decades.

China

Production 1979: approximately 150,000 metric tons

China's lead production capacity was supposed to have reached 250,000 to 300,000 metric tons per year. This figure, however, is relatively high, in light of the figures obtained for this study. Nonetheless, the lead (and zinc) picture for China is much more promising now after new discoveries of both ores have been announced. Several large deposits are known and they should be listed here besides other deposits. The

arrangement is by province.

Kwangsi Province

The Lanping deposits, which are located in the Chintang mining district near Hochih. Although mainly a tin deposit, it is tens of kilometers long. Production is 5,000 tons of lead. Reserves of contained lead and zinc have been noted as 14 million tons! (8-10% since lead-zinc plus others).

Gansu Province

There is a major lead-zinc belt counting 1,200 km^2 containing 7 million tons of ore. (Cheng Xian deposit)

Hunan Province

One deposit is near the old Shuikoushan mine site with 1 million tons of ore.
The famous Zhuchou smelter is located in this province with a capacity to smelt 50,000 tons of lead and 120,000 tons of zinc. This province has an additional 10 lead-zinc mines.

Fujian Province

In the western part of this province, there is a smelter with unspecified capacity.

Guangxi Province

There is a lead-zinc mine at Sidin. Capacity is not given.

Liaoning Province

This province has various lead and zinc mines; a smelter is located at Shenyang with a capacity to produce 40,000 to 50,000 tons of lead and 15,000 to 20,000 tons of zinc.

Guangdong Province

The Fankou smelter is located here at a mining camp with an ore reserve of 30,000,000 tons containing 5 percent lead, 11 percent zinc and 120 grams of silver per ton. The capacity of the smelter is to produce 6,150 tons of lead in concentrates of 100% (!)

Shaoguan Province

The Imperial Smelting Process Smelter (ISP) is found here with a capacity to produce 18,000 tons of lead and 35,000 tons of zinc.

Quinghai Province

A deposit is recorded in this area. It runs under the name of Xitieshan deposit.

Sichuan Province

This province is known to have many lead and zinc deposits.

Tsaidam Basin

This area is also known to have many lead (and zinc) deposits.

The deposits in the last two provinces and the ChenXian deposit in the Gansu Province have been inspected by Mitsubishi Metal Corporation which had been asked by China for assistance in the development of the Chinese lead and zinc industries. Whereas the Chinese aimed at a profit-sharing arrangement with the Chinese paying for the assistance in metal products, the Japanese preferred payment in cash, at least as part of the proposed deal.

However, in light of the overall position of China as an industrial nation, it would not appear that China would be a competitor in the world market on more than a temporary basis. China's industrial development requires a considerably large amount of lead (and zinc) if it wants to match the industrial standards of other countries. In the long run, as China makes

huge progress, it will need very large amounts of lead, by any stretch of the imagination. This is a country of one billion people which has substantial lead reserves which may even be larger than indicated in Table 13.

Bolivia

Production in 1979: 15,700 metric tons

In the South American country of Bolivia, a joint venture is under way, undertaken by Comibol and ENAF to build a smelter to produce 24,200 metric tons of lead. The cost is $124 million and it is located in Karchi Pampa near Potosi in Bolivia. It will be constructed with the firms of Kloeckner of Germany and Sidech supplying the technology. They will utilize the Soviet Kivcet flash smelting process. Operations are to start in 1982. Whether this smelter is going to be the success for the industry in Bolivia is another question. This reason is that the mining industry in Bolivia is suffering from several ills. One is that the smelting operations are in the hands of ENAF, which is a state monopoly and the private mining companies complain that the smelting cost is too high and their returns are too low. Nonetheless, the general tendency of this operation is to smelt the ore domestically and reduce the exports of ores and concentrates.

Yugoslavia

1979 production 78,900 tons

Yugoslavia is a very important lead producer and it is claimed that this country produced 111,040 tons of refined lead in the year 1979. A brief listing of the main lead operations (and zinc) will demonstrate this point of importance, particularly since new discoveries occurred in Yugoslavia, a competitor in the foreign markets which Canada has to reckon with. The main industrial mining complex is the Trepca Combine, which is presently expanded.

The Trepca Combine produced 65,000 tons of lead and 56,000 tons of zinc. It has an ore capacity of 4 million tons per annum. The Kopaonik mining enterprise which is part of the Trepca Combine and which is located at Leposavici is in the process of increasing its capacity from 120,000 metric tons to 150,000 metric tons per year. A new shaft at the Gomile mine is planned which has a reserve of 2.5 million tons of ore with a metal content of 10 percent (1) lead. It will be in full operation in 1981. At Leskovac, the government enterprise intends to increase the mine operations from 100,000 tons of zinc-lead ore to 240,000 at a cost of $50 million. Furthermore, the Sasa lead-zinc mine at Kamenica in Macedonia produced 24,000 tons of lead concentrates and 28,000 tons of zinc concentrates. This mine has an ore reserve of 13.5 million tons. Another mine is the Blagodat mine in Serbia. It will raise

its ore production to 500,000 tons per year from the present 300,000 with an ore reserve of 30 million tons. Recently, the Kriva Palanka lead-zinc deposit was discovered. It has an ore reserve of 10 million tons. An open-pit mine is planned with an annual capacity to haul 60,000 tons. Finally, there is the Titov smelter in Macedonia. It was supposed to be in operation already in 1980 to deliver 25,000 tons of lead (and 50,000 tons of zinc). The output of this complex is earmarked for exports to the U.S.S.R., U.S.A., Hungary and Czechoslovakia. In short, there cannot be any doubt that this country will significantly contribute to world competition in lead in the years to come.

Other countries

South Korea, Spain and Ireland

Some other producers should be mentioned which will eventually be more significant producers in the world than is presently the case. One of these is South Korea. In 1979, it produced 12,520 metric tons of lead. The Knyo Zinc Corporation is constructing a smelter in Onsan, South Korea. It will have a capacity of 30,000 metric tons of lead per year and will be in operation in 1981. This will be an addition to the existing capacity of the Korean Mining and Smelting industry which stands at 38,000 tons of lead produced annually.

Spain

The lead industry in Spain which had lost considerably in capacity since 1950 has not yet succeeded to replenish its smelting and refining potential. However, it is still a very important producer of medium size and plans to increase its lead output between 1980 and 1987 by about 21,000 tons. This is mainly through the opening of new mines.

Ireland

Ireland is another country which will increasingly contribute to the production of lead in the world. Between the years 1968 and 1977, its lead output fluctuated between 62.5 and 32.6 thousand metric tons per year. In 1979, this output stood at 71,000 metric tons. Ireland became famous in the lead-zinc mining industry through the Navan deposit discovered by Tara Mines. Other deposits have been discovered and one company, Bula Mines, has applied for starting an open-pit operation as early as 1986. The investment would amount to $100 million and produce 130,000 tons of concentrates. At the same time, the Irish Development Authority was contemplating an investment of $200 million to build a new smelter with a capacity of 100,000 metric tons. Although the outcome of these intentions have not fully materialized - the Bula Mines project has met stiff opposition on environmental grounds - eventually, the Irish lead potential will be raised in the future to more than

double its present capacity, especially since additional ore reserves are known to exist close to the Navan ore body.

East Germany

Finally, there is East Germany. It has been included in this discussion in spite of the fact that, as a lead ore producing country, its last recorded production took place in 1973 with merely 3,000 metric tons (United Nations Statistics). This very important industrial country among the centrally planned nations is known to have planned the construction of a huge secondary lead plant in Freiberg, Saxony. As Metals Week reported, this plant will have a capacity of 120,000 metric tons per annum at a cost of $90 million. It will be constructed by an Italian firm which will also provide the necessary technology. This addition alone is almost equivalent to the total refining and smelting capacity of Spain in the year 1979. There is no doubt that this plant will not fail to be an important and economically strategic enterprise in the area of lead production for centrally planned economies of Eastern Europe.

SECTION V: PROJECTION OF PRICES, PRODUCTION (DEMAND) AND CONSUMPTION

Prices

Past Lead Prices

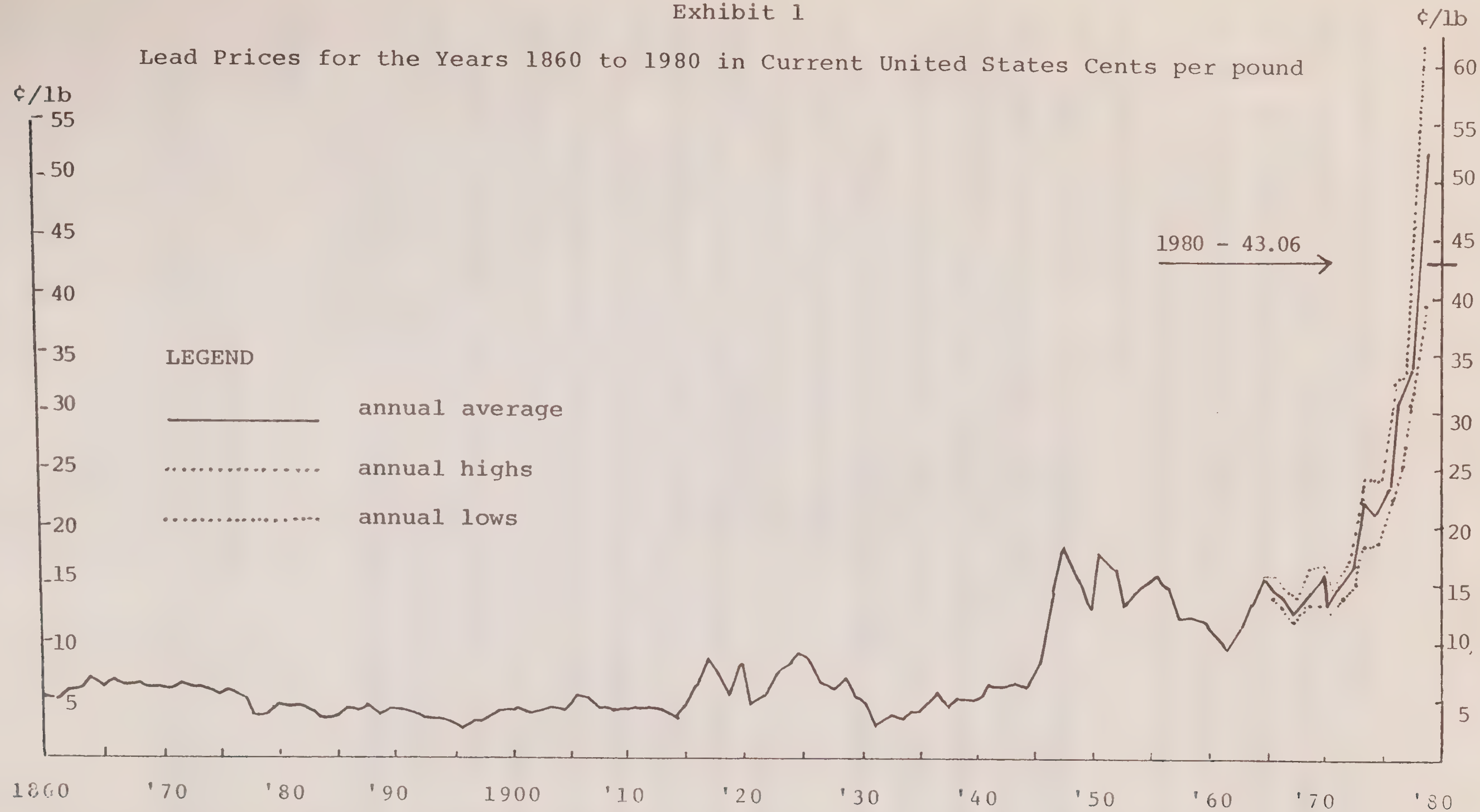
The history of lead prices is well documented and can be traced back to the Romans. Its literature is substantial and new summary statistics are added continuously. One of these new contributions is by Christopher Schmitz, who presents a review of world non-ferrous metal prices and outputs in comparable terms.[14] It is referred to here for those interested in history of metal prices prior to the periods covered. However, it is important to record that Schmitz has not been used in any way or form as a base for the statistical analysis undertaken in any area of this comprehensive study.

Exhibit 1 traces the behaviour of lead prices since 1860 starting at a price of about 5 ¢/lb which, when tracked back through Schmitz does not display any dramatic change since the year 1700. During the First World War, and then again during the 1929s, the lead price increased only to return to previous low levels for the 1930s.

During the Second World War, the price of lead remained fixed in the United States. Immediately afterwards, it rose to a new level of about 15 ¢/lb around which it fluctuated right until the early 1970s. Only then did the price of lead take off to settle at 43.06 ¢/lb in current U.S. currency in the year 1980.

Exhibit 1

Lead Prices for the Years 1860 to 1980 in Current United States Cents per pound



Source: same as "Zinc". Exhibit I. p.46.

The general price inflation, as discussed explicitly and extensively in the chapter on gold, did not pass by the base metal lead. This rise is of particular importance, considering that there has not been any great shortage of the resource at all and that the demand, at least in North America, has been greatly disappointing. The point of interest turns now to the expected behaviour of lead prices.

The Future of Lead Prices

The expected prices of lead in constant 1979 U.S. currency are given in Table 14. This behaviour is also illustrated in Exhibit 2. This expected performance derives from the econometric model developed for this study by Dr. E.T. Willauer. The conditions surrounding the econometric analysis have been explained in Chapter I and some other statistical and methodological aspects have been pointed out in the study on gold. These conditions and aspects are likewise of importance for the proper interpretation of all the results presented here for lead; and they shall not be repeated.

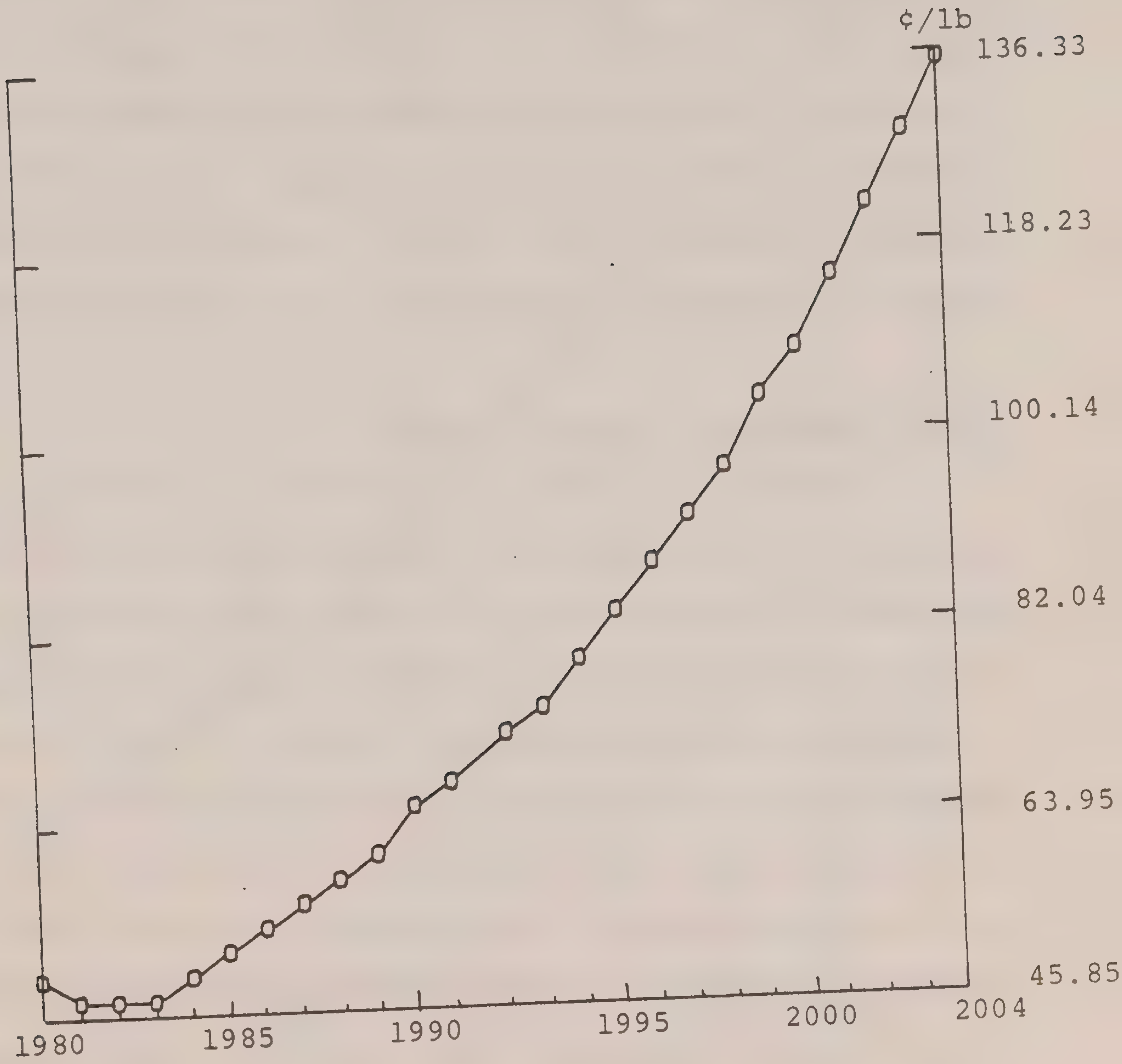
Lead prices will remain relatively low in the range between 45.85¢/lb and 50¢/lb right to the middle of the 1980s. This expected price picture reflects quite convincingly the present world market conditions where lead does not constitute a resource problem at all. However, with the growth of the world economy

Table 14

Year	¢/lb in constant 1979 $U.S.	Lead mine Supply (demand)	Lead Primary consumption (technical variable only)
		'000 metric tons	
1980	48.91	3833.81	3672.02
1981	46.60	3985.67	3711.81
1982	45.85	4094.21	3748.67
1983	46.33	4185.64	3783.99
1984	47.68	4274.22	3818.50
1985	49.62	4366.29	3852.54
1986	51.96	4463.85	3886.21
1987	54.57	4566.85	3919.54
1988	57.38	4674.58	3952.51
1989	60.38	4786.26	3985.09
1990	63.57	4901.28	4017.27
1991	66.94	5019.27	4049.06
1992	70.51	5140.03	4080.47
1993	74.31	5263.50	4111.49
1994	78.35	5389.71	4142.16
1995	82.65	5518.71	4172.48
1996	87.22	5650.57	4202.46
1997	92.10	5785.38	4232.12
1998	97.29	5923.22	4261.48
1999	102.82	6064.17	4290.54
2000	108.71	6208.33	4319.32
2001	114.99	6355.73	4347.82
2002	121.66	6506.42	4376.06
2003	128.77	6660.47	4404.04
2004	136.33	6817.91	4431.78

Exhibit 2

Projected Lead Prices in Constant 1979 U.S. Currency
for the Years 1980 to 2004



and the industrialization of the developing countries, the price will steadily rise at first, and then, after 1990, it will climb at an increasing rate. By the year 2000, the lead price will be 108.16¢/lb. This acceleration is a definite reflection of the growth rate parameter underlying the econometric model. However, the authors of this report are cautious in accepting the predicted prices beyond the year 2000 without query. There is no doubt that the actual rates of world growth as will unfold in the years ahead will influence the lead market conditions accordingly such that the prices beyond the year 2000 are conditionally valid if, and only if, the actual GDP growth rates match the parameter values used in the econometric model.

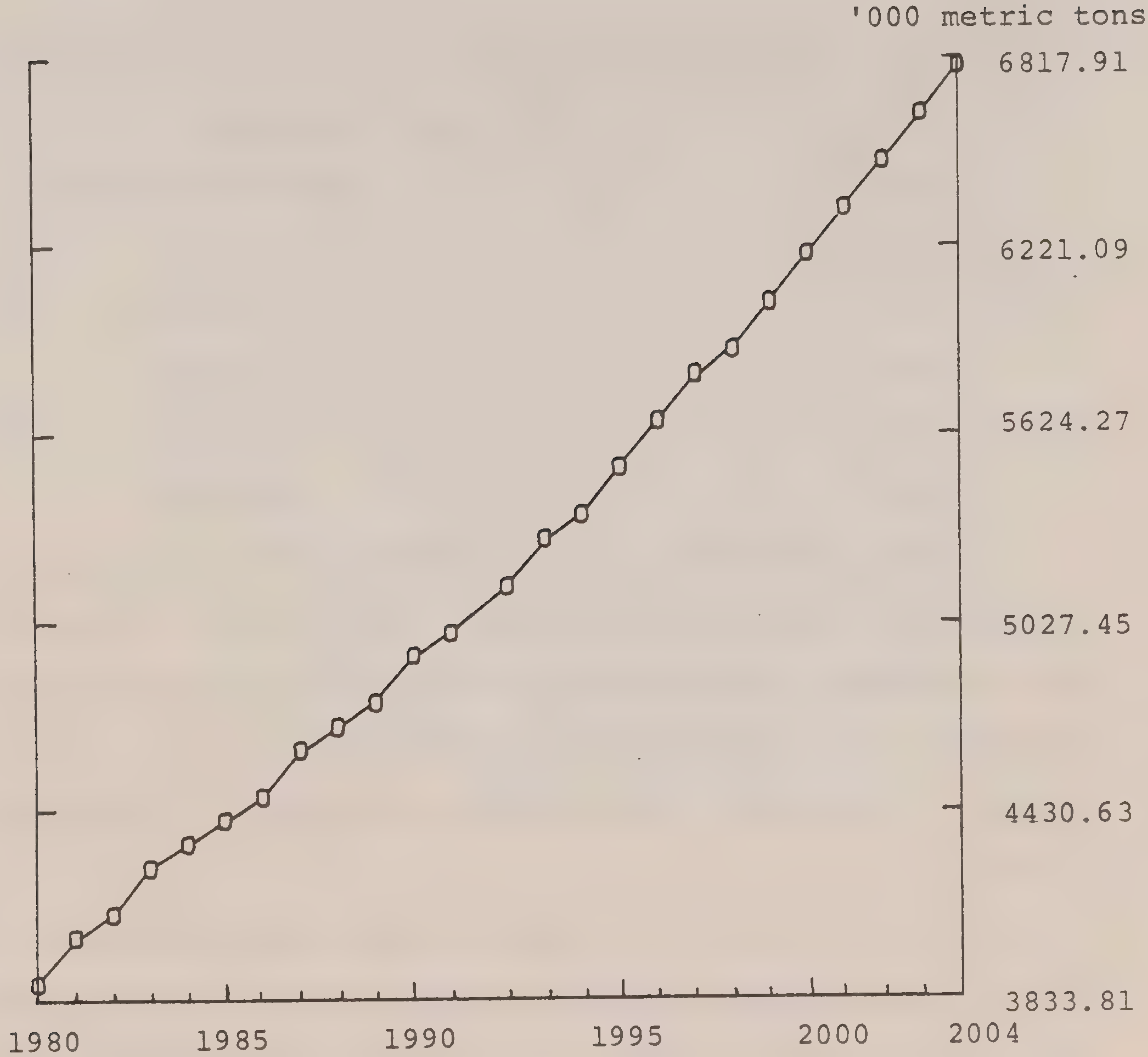
Mine Production: Supply Demand

The expected output of lead mines of the world is shown in Table 14 and in Exhibit 3. From a world lead mining output of 3,599,020 metric tons in the year 1979, the supply of mined lead, as a whole, will climb slowly at first to accelerate later in accordance with the prices of lead. In 1980, the estimated supply of lead is given as 3,834,000 metric tons and by the year 2000, it will have reached 6,208,000 metric tons. In 2004, the predicted demand = supply situation of mined lead will be 6,817,000 metric tons. The reservations as to the validity of these figures, especially after the turn of this century, are the same as expressed for future lead prices.

Exhibit 3

Projected World Lead Mine Production for the Years 1980 to 2004

in '000 metric tons



However, it should be pointed out that the increases of mined lead are very reasonable in the faceof the increases experienced in the past. This projection means that the demand (= supply) for mined lead will rise by a factor of 1.778 over the next 25 years compared to an increase by a factor of 2.33 for the past 30 years. This, on an annual average, is a 10 percent lower expansion rate than experienced over the precious period.

The cumulative volume of produced lead over the forecast period is provided in the following breakdown.

Year	('ooo metric tons)
1985	24,739
1990	48,132
1995	74,463
2000	104,085
2004	130,436

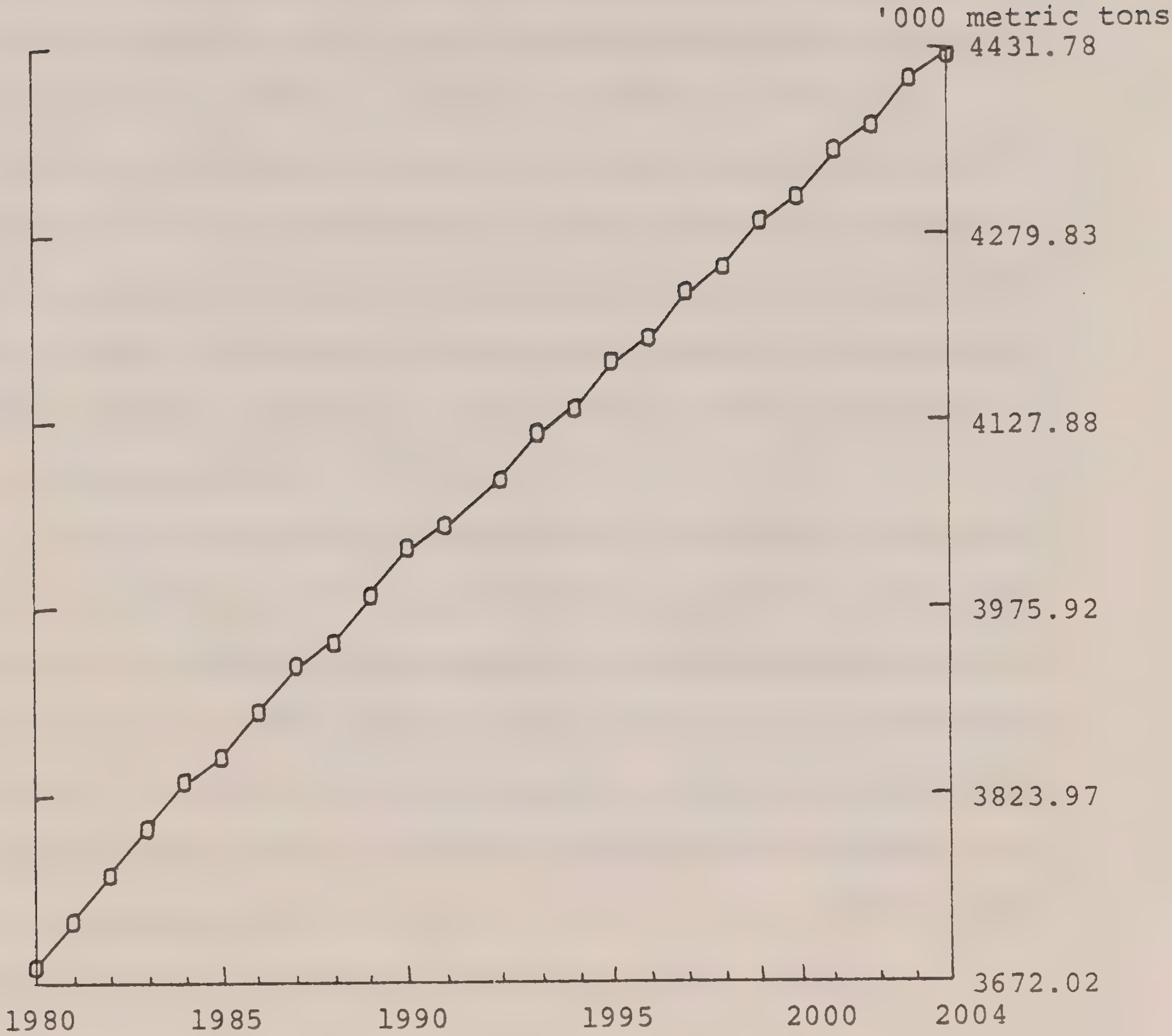
It shows that by the year 2000, 104 million metric tons of lead will have been mined. This amounts to one third of the overall reserves and to 70 percent of what could be labelled 'short-run reserves' of about 150-165 million metric tons, not mentioned in the earlier assessment of long-run reserves.

This forecast is somewhat lower than that offered by the U.S.B.M. in the year 1974. Their primary demand amounted to 4,681,000 metric tons in 1985 and to 6,867,500 in the year 2000. Dr. E.T. Willauer's projection stands at 4,366,290 and 6,208,330 for those years respectively.

Exhibit 4

World Consumption fo Primary Refined Lead for the Years 1980 to 2004

in '000 metric tons



Lead consumption

The industrial consumption of primary lead, which stood at 3,926,000 metric tons in the year 1979, will, of course, continue to rise and it will be in approximate balance with the future supply = demand balance of mined lead. Since secondary lead plays a very significant role, the primary demand will increase at a lower rate than actual consumption of primary and secondary lead. This secondary use increases with the ever-increasing quantity of the lead stock in use.

The lead consumption figure of Table 14 and in Exhibit 4 have, therefore, to be read very, very carefully. They tend to reflect the general trend in consumption in face of this secondary lead and they are not the absolute figures. It would require a special model of primary demand analysis which is beyond the scope of this study. However, the past consumption values were utilized in the econometric analysis as they establish a technical relationship to production and to total final industrial consumption. This consumption variable was used specifically to close the mathematical system of equation. It is due to the specific nature of the variable that the predictibility of prices and production of mined lead have a greater reliability than would be the case without that variable.

SUMMARY AND CONCLUSION

World consumption of lead increased by 224 percent between the years 1950 and 1973 when it levelled off mainly due to environmental policy changes. By the year 1979, it had decreased over its previous height by roughly 10 percent.

In the year 1950, the world relied on 88.3 percent of mined lead. By 1979, this reliance had significantly dropped to a mere 70 percent.

During this period, the U.S.A., which once consumed 46 percent of all lead, saw its consumption position reduced to 25.4 percent at the end of this time period. In contrast, the other industrialized countries and those in the process of speedy industrialization displayed a sharply rising rate of lead consumption.

The use of lead is a reflection of the degree of industrialization itself. In the U.S.A. between 65 and 70 percent of lead are needed for automotive related purposes and in heavy equipment. Therefore, the worldwide increase in lead consumption is an unmistakable expression of the rapid degree of industrialization which is taking place in a considerable number of countries such as Japan, Italy, France, West Germany, Yugoslavia, China, Poland and, above all, the U.S.S.R.

World mine production of lead increased though at a lower rate than its industrial consumption. As a world producer, Canada has maintained its position, but it is in a vulnerable position if the world experiences a period of recession. Canada's lead production depends to about 96 percent on exports which have increased although our customers, which include the U.S.S.R., seem increasingly to prefer lead ores and concentrates rather than lead bullion on which most levy a tariff. Between 1977 and 1979, Canada doubled its lead trade balance in terms of Canadian dollar receipts. However, Ontario is an unimportant participant on the lead scene.

In North America, both the smelting and refining capacity of lead have been dramatically reduced during the period under study. This stands in contrast to the other lead consuming countries which have substantially expanded their smelting and refining works relying heavily on the import of ores and concentrates and on secondary lead.

North America holds more than 50 percent of the world's lead reserves; the United States alone counts for 36 percent and is, thus, the world's largest lead storehouse. Canada is the second largest holder of lead reserves, followed closely by the U.S.S.R. and Australia. All these countries combined account for over 70 percent of all lead ore.

In spite of its huge lead deposits, the U.S.A. is significantly dependent on the import of lead with a substantial part

of this supply originating in Canada in both refined and unrefined form.

The U.S.S.R. is a rapidly rising industrial consumer of lead but manages to be a net exporter of the refined metal possibly, on a net basis, reexporting Canadian ores and concentrates as refined lead. Other countries or regional entities displaying a rising performance of lead production are: Australasia, Mexico, China, Bolivia and Yugoslavia. The latter is in the process of becoming one of the most important competitors in Europe and also ships lead to the Soviet Union.

Since the year 1700, the price of lead has remained relatively low, stable but flexible, rising and falling during and after wars respectively, except during the Second World War when it was fixed. Only in the 1970s did it start to move permanently into higher grounds.

These prices, when seen in constant 1979 U.S. dollars, will continue to rise. The econometric prediction is that they are likely to break through the $1./lb mark by the turn of this century. The production of mined lead will be over 6.2 million metric tons by then and possibly at the 6.8 million metric ton level by the year 2004. All these projected values are subject to previously specified conditions. Comparatively speaking, this expected increase is at a lower average rate for the next 25 years than was the average for the previous 30 years reflecting a significant absorption of secondary lead.

The projected consumption values reflect technical relationships of the econometric model and are relevant only in a minor role.

The following conclusion may therefore be drawn. In Canada, the future of the lead mining industry will be assured through the size of the ore reserves alone. However, since Canada's smelting and refining capacity has not kept pace with the industrial expansion of other lead-using countries, the main share of future lead production will increasingly have to take the form of mined ore instead of refined lead unless a fundamental change in approach takes place. It appears certain that foreign customer countries will express a rising interest in our ores which they are easily able to smelt and refine themselves as their smelting and refining capacities increased while ours declined. Indications are that lead smelting and refining of other customer countries have become more market-oriented rather than supply-oriented which had been to our benefit. In addition, future competition will be strong as other potential suppliers are closer to the industrial users, a condition which, to be overcome, would require very extensive marketing efforts by Canada. Our position is also vulnerable as regards sales to the United States. Should this country decide to alter its import-dependency on lead and reorient itself towards national self-sufficiency in the years ahead - a possibility which should not be precluded entirely - then, our trading position in lead versus that country would be severely affected.

On the positive side, there are two factors which improve the overall prospects: a relaxation of anti-pollution controls may and the coming into use of the battery-powered electro-vehicles will see a step-up in lead consumption. There is no question that the future is now brighter than it was several years ago. The point is that since the reduction of lead consumption for environmental reasons had definitely changed the norm of the input structure in the western industrial world, the lead industry had to adjust to these new conditions. The present situation marks the essential point that this adjustment has occurred and that, basically, the future lead demand must grow in accordance with the growth of the world economy - and that of the western economies for that matter - which is reflected in the econometric forecast. Nonetheless, even if the future of the Canadian lead industry is assured, it is clear that it will not be as bright as it would have been had certain events not taken place which were largely beyond our control.

NOTES

1 Atomic weight of 207.21, specific gravity 11.4, melting point 621°F; boiling point 2777°F.

2 For a brief history of the rise to fame of lead, see: J. Patrick Ryan and John M. Hague, "Lead", Mineral Facts and Problems, 1975. op. cit. p. 592. That brief section refers to the use of lead in antiquity as far back as the year 3000 B.C. in Abydor; then in Egypt, Babylon, Rome from where it derives it scientific symbol of Pb, for plumbum, the Latin word for lead. The Phoenicians had mines on Cyprus, in Sardinia and Spain, while the Roman lead-silver mines were located in Britain, Sardinia and Spain. In the United States, lead was first discovered in Virginia in the year 1621.

3 These figures represent a comparison of basic data and are not, in the statistical sense of the terms BLUE values.

4 Table 2

5 See Technical Information Paper No. 2 of this study, p. 7-8.

6 Infra, "Reserves and Alternative Suppliers".

7. cf. U.N., Statistical Yearbook, 1977, New York, N.Y. 1977, Table 62; and ABMS, Non-ferrous Metal Data, 1979, New York, N.Y., p. 45; 49 in the former, and 42 in the latter. cf. also J.P. Ryan and John M. Hague, loc. cit.

8 Ibid., p. 592.

9 IMMR, 1980, p.

10 For instance, the Honduras El Mochito precious and base metal mine which is 100% owned by Rosario Resources of the United States merged with the AMAX Corporation. This is one case in point. This mine produced 17,934 tons of lead in 1979. Its mill will increase its tonnage of ore mined from 1500 tons/day to 2500 tons/day late in 1981 or early 1982. In a similar light, the Canadian Cyprus Anvil Corporation which was owned to 63 percent by the American parent firm is now merged with Amoco CYM of the United States. This company has plans to open up a mine at Faro in the Canadian Yukon replacing the Vangora & Grun deposits in 1985 at a cost of $240 million.

11 IMMR, 1980, ibid., pp. 182- 183; see also the Mining Annual Review, 1980, London, 1980, p. 598.

12 Cf. Engineering and Mining Journal, January editions, 1979, p. 99; 1980, p. 81; 1981, p. 69.

13 Metals Week, March 24, 1980, p. 2.

14 Christopher Schmitz, World Non-Ferrous Metal Production and Prices, 1700-1976, Frank Cass, London, U.K., 1979; for lead prices see pp. 275-279. In 1700, the price of lead in England was 7.87 L/t which rose to 12.30 L/t by 1724. It stayed at that level until 1781 (16.73 L/t in 1747), then climbed to 20.87 L/t in 1787, reached a high of 30.66 L/t to decline to 11.47 L/t in 1832. This marked a low for the price of lead which also reappears in the year 1902, and later, though even lower, at a price of 10.76 L/t in 1932. The historical height was 37.23 L/t in 1920. The series for the United States starts in 1812 with 246.03 $/t, or 11 ¢/lb; 1815, 17.9 ¢/lb; 1819, 6.7 ¢/lb from where it declined to 3.7 ¢/lb in 1829/30, rising later to 6.9 ¢/lb in 1864. This links into our Exhibit 1 in 1860 with a price of 5.6 ¢/lb.

SOME FUNDAMENTAL ASPECTS OF MINERAL POLICY IN COMPARISON: U.S.S.R., Japan, and the United States of America

The purpose of the following discussion is to bring out developments and conditions in three of the most important industrial countries of the World. The necessity for this discussion arose as it became obvious that the relative rate of industrial expansion over the last two decades changed in favour of some countries and against others. In order to explain the reasons for this development it was thought a necessary, preliminary step to shed some light on the basic policies for economic development in these countries and, thereby, also to see the significance of the respective general mineral policies. The results are clearly perceptible: Japan's policies reflect a systematic coordinated effort by public and industrial agencies. The U.S.S.R. centrally directs and force-feeds industrial and mineral development, while the policy in the United States leaves mineral policy to market forces exposed to a multitude of restraining rules. The changing picture therefore should not surprise the beholder.

The obvious problem discussed in this exposition of the alternate suppliers of minerals in the world is the position in which, above all, the United States finds itself. How is it possible that the world's largest resource holder of lead, for instance, is import-dependent as to this metal? Why are the

United States of America not net exporters of lead? Certainly, it is not for reasons of an unwritten policy to conserve the mineral resources of the United States !

Another point that has to be mentioned in this context is the Canadian position in which we fortunately find ourselves. There is no doubt that the Canadian mining industry benefits from the export of lead to the United States and any move towards U.S. import independence in the field of lead would be of detriment to the Canadian mining industry and the trade balance of this country. Therefore, it should be clearly understood that any argument presented in the following discussion is not to be interpreted as an attempt on the part of the writer to suggest any change on the part of the United States to the detriment of the Canadian mining industry. Far from that, the purpose of this discussion is to bring into comparative focus industrial policies of the three most industrialized countries of the world. The countries whose approaches to industrial policies will be studied briefly are Japan, the U.S.S.R. and the U.S.A. Eventually, it will have to become clear that the strategies employed by each cannot fail to have effects on the other countries as all are connected in several ways to the world economy which they influence by their actions.

Japan

No country is so dependent on imported raw materials as the industrial colossus of Japan. In 1979, it imported substantial quantities of basic minerals, some of which are presented in the following table.

1979: Japan Import Picture of Silver, Copper, Lead, Zinc and Nickel

	Silver (oz)	Copper (oz)	Lead (tonne)	Zinc (tonne)	Nickel (tonne)
Total Demand	2172 023	1353 805	275 832	791 694	33 100
Imports (%)	57.5	81.8	61.9	61.4	138.4
(Primary & Secondary)					
Supply	2577 307	1588 689	295 769	1091 049	56 302
Imports	1249 307	1108 336	170 635	485 805	45 803
Imports (%)					
Supply	48.5	69.8	57.7	44.5	81.4

Source: Mining Annual Review, 1980, London, p. 483.

No matter how this statistical table is read, whether from the points of view of demand or supply, the fact remains that Japan is critically dependent on the imports of minerals. This is also true for precious metals, for which Japan cannot claim self-sufficiency. The most critical area remains the field of energy.

APPENDIX 1

SOME FUNDAMENTAL ASPECTS OF MINERAL POLICY IN COMPARISON:

U.S.S.R., JAPAN, AND THE UNITED STATES OF AMERICA

"The nationalist overtones are also clearly discernible whereby growth of exports was conceived as victories on the battlefield of the international economy."

Johannes Hirschmeier,S.V.D., and Tsunehiko Yui,The Development of Japanese Business,1600-1973,Harvard University Press (Cambridge,1975),p.313.

How does Japan solve these problems? The first aspect is that Japan is made aware of the seriousness of this dependency in the sense that it is common knowledge that its economic survival necessitates a solution to this ever-present problem. Japan has virtually to live up to these conditions of scarcity of resources on a day-to-day basis. To beat the problem, a continuous and systematic cooperation of the most influential institutions is required. They are: the industrial corporations, including the major mineral companies, the government and the universities. It would appear that there is a very close synchronization of these institutions.

In the mineral field, the Geological Survey of Japan is involved in the basic research for geophysical and geochemical prospecting.[1] Here, the emphasis is on domestic prospecting, but mineral exploration also extends far into overseas. This basic research is also carried out in the laboratories of the private mining companies and at the universities. In addition, there is the Mining and Metallurgical Institute of Japan which is centrally involved in the resource research field by three committees:

(a) the Geological Structure General Analysis Committee,

(b) the Geophysical Prospecting Committee, and

(c) the Geochemical Prospecting Technique Research Committee.

The importance of the MMI of Japan will be realized immediately upon recognition that these three committees are stacked by specialists from Japan's universities, research laboratories and the mining companies. In this fashion, combined and concerted efforts are made to assure the best possible solution to the problems which emanate from the cooperation at a high level of important institutions.

Externally, the point is made that Japan does not operate as strongly in the area of exploration as at home. It would appear that this is a recommendable policy, for, were the Japanese as aggressive as they are at home, friction would result with the host countries. In this way, Japan adjusts to the conditions prevailing in the countries in which exploration activities are under way. It is the Metal Mining Agency of Japan which is in charge of surveying foreign countries. For instance, in 1979, such surveys were conducted in ten countries and these activities included geophysical prospecting, core drilling and drift surveys.

Areas of exploration were:

British Columbia	Eastern Sudan	Northern Thailand
Northern Canada	Central Phillipines	Central and Eastern Brazil
Northern Peru	Central Niger	Southern Bolivia

Joint venture geological survey and exploration programs were also carried out. These took place in Canada, Mexico and

Australia. Included should be likewise joint ventures in resource development in Honduras and in other countries. Another step was a Japanese-Soviet natural resource development conference which took place in Moscow on September 27, 1979, to investigate the gas and oil fields of Yakutsk and the Sakhalin.

In addition, another company plays a very important role: The Power Reactor and Nuclear Fuel Development Corporation. It is heavily involved in uranium exploration programs either completely independently or in cooperation with companies and governments of the various host countries. Such exploration efforts extended into: British Columbia, Wyoming and Oklahoma in the United States, eastern parts of Africa, Western Greece, Gabon and Australia, with very promising results, especially in British Columbia.

Another area of critical importance is mineral processing technology. Japan pursued a vigorous policy as government institutions, universities, and private companies are heavily engaged in research with special attention being paid to high intensity magnetic separation, mineral treatment processes for ultra-fine particles and effective methods of extraction in the use of tailing sludges. Of special interest is that, here too, the same Mining and Metallurgical Institute of Japan is a strong supporter of these activities.

In short, there is a strong and concerted effort being made by one government, the universities, the research laboratories and the industries to solve the resource problem, including energy. In this endeavour, they are all linked to and supported by the MMIJ to provide for the mineral needs of Japan by drawing systematically on both domestic and foreign resources.

In this attempt, however, Japan has never lost sight of the dangers when relying on foreign supplies. It has been a consistent policy of Japan to assure the availability of the various raw materials, preferably from as large a number of countries as possible. This is to reduce the risk of supply shortages in case resource countries fail to deliver for whatever reasons. Nonetheless, it is also obvious that the cheapness of the supply has its own function in this strategy. For instance, Japan, in all its attempts to spread the risk, has not become a nickel customer of Canada, although Canada is one of that country's most important customers in manufactures.

How successful Japan has been in its drive to secure raw material resources can best be seen by an event that took place recently and which has not received sufficient public attention as it explains the delicate balance in which two countries find themselves in the field of mineral resources. Specifically, it demonstrates a dependency reversal in the sense that a mineral-rich country has come to depend on an overseas country for the

refining of ore which it cannot undertake any longer at home. The country in question is no other than the United States of America. Very much to the surprise of many, The Anaconda Corporation decided to close irrevocably its Anaconda, Montana, smelter and its Great Falls, Montana, refinery, and to have its copper concentrates refined in Japan over the next seven years. Anaconda saw itself forced to that move for a combination of factors. One was that it was uneconomic to continue treatment of ores at home, while the other was related to the clean air standard requirements of the Environmental Protection Agency. Even the Congressional Copper Caucus in the U.S.A. pleaded in vain as it could not influence the decisions by Anaconda in a more positive way.

Phelps Dodge is another candidate in this direction. It has the intention of closing its Douglas, Arizona, and Ajo, Arizona, smelters, with part of the ore to be exported for processing.

The U.S.S.R.

The mineral industry of the Soviet Union has to be understood as an integral and key part on the blueprint of the autarchic economy. Ideologically, this blueprint assigns an absolute priority function to the raw material industries without which no

manufacturing industry can exist in the self-sufficient economy. In this sense, the mining industry is the foundation, and, thus, the necessary precondition for economic development. The autarchic economy of the centrally planned variety implies mineral self-sufficiency at any price.

Therefore, it should not come as a surprise that the mineral industry is a vital cornerstone of the industrial structure of the U.S.S.R. This industry is totally state-owned, organized and has been centrally orchestrated ever since 1929. The position of this industry is so eminent and so critical that actual or estimated costs of production in the U.S.S.R. are only of secondary importance. Purely financial and economic aspects of production and prices are irrelevant. This holds for the prices of both domestic and foreign sales as long as the final objective is being served through such action. In this way, there is no doubt that the U.S.S.R. economy subsidizes, explicitly and implicitly, metal prices and thus, the mining industry in order to accomplish the economic as well as the political targets of the system. Regardless of how uneconomic the resource allocation is in terms of the Western economic thinking, the purpose justifies the means, especially when it goes hand-in-hand with low labour cost, one of the areas of incidence of this subsidization.

In this strategy, the U.S.S.R. utilizes four groups of resource suppliers. They are:

(a) Domestic resources

(b) Comecon countries

(c) Industrialized Western countries

(d) Non-communist and/or developing countries

Domestic resources

Regardless of how poorly some of the mining sectors are allegedly equipped, the domestic workforce employs three million workers in the ferrous and non-ferrous metal industries. This relates to a total domestic workforce of 110.6 million or 2.7 percent. In order to understand the relative importance of this sector and of the technical profession in general, it should not be forgotten that the U.S.S.R. has 3.5 million engineers. In 1979 alone, 155,000 mining engineers graduated from 38 Soviet institutes. This is not necessarily a society of social welfare institutions, facetiously speaking, but an expression of a totally integrated, technical society.

Comecon countries

This labour force of the U.S.S.R. is enlarged by considerable numbers of people from satellite countries working in the U.S.S.R. as more or less invited contract workers. It would appear that these people come chiefly from Poland, Bulgaria and the German Democratic Republic.

However, the additional main emphasis in the general scheme of economic planning in the U.S.S.R. is the more recent focus on economic-industrial integration and cooperation among COMECON countries. These activities consist of large industrial projects which are jointly undertaken, but they exclude mineral projects as the COMECON countries have to rely, in their mineral needs, on the supply from the U.S.S.R. on which they are dependent. This holds for Eastern Europe, Mongolia, Cuba (except nickel) and Vietnam.

In the industrial fields, recently the agreement has been reached among COMECON members - in good planning fashion - to quadruple the level of joint investments for each of the five-year plan periods for 1981-1985 and for 1986-1990, over that of the previous plan period 1976-1980. In this way, the industrial strength of all can be increased, including that of the U.S.S.R., while the simultaneous mineral dependency of the satellite countries on the U.S.S.R. increases.

Industrialized Western countries

Thirdly, the U.S.S.R. has greatly enlarged the scope of economic relations with the Western industrialized countries. Economic cooperation - following the lines of the New Economic Policy of the 1920s and 1930s - comprises long-term agreements on the development of economic, scientific, technical and

industrial cooperation with the U.S.S.R., which is, as is generally recognized, the largest and one-sided beneficiary. Countries so involved are the U.S.A., West Germany, France, Italy, Austria, Denmark, the U.K., the Netherlands, Portugal and Switzerland. They and their companies help to build up the industrial power of the U.S.S.R. This cooperation entails industrial construction projects, the expansion and modernization of existing industries and scientific research!

A particularly interesting form of cooperation is the so-called "compensation" or "buy-back" agreement . Under such agreements, huge industrial enterprises are built in the U.S.S.R., financed by international credit, which is to be repaid in the form of produced commodities. Through this approach, the U.S.S.R. assures for itself the formation of its own industrial capital produced and financed by the Western industrial nations and industries, capital that cannot be at the services of the Western countries; in turn, final commodities are entering the same Western countries which slowly do recognize the dislocation and disruptions which these commodities are bound to cause, especially in the field of chemical products.

These industrial enterprises which have been and still are constructed in the U.S.S.R. under these agreements, are

large by any stretch of the imagination. They involve the giants of Western industrialization: Krupp, Daimler-Benz, Creusot-Loire, Schiess, Occidental Petroleum, Exxon and Asea of Sweden to name a few. The amounts of investment goods provided go into the tens of billions of dollars. One project alone which has been under discussion for some time concerns a gas pipeline from Western Siberia to Europe. It would cost $11.6 billion to build and could be on stream in 1986. West German energy companies are the main western industrial cooperators. Consequently, this form of cooperation, through the construction of such mammoth projects, helps to build up the industrial giant of the U.S.S.R. even faster than that country would do without our Western industrial strength. This means that huge capital is placed into the hands of the labour force of the Soviet Union, capital which cannot be used to employ people in the Western industrialized nations.

It has to be added that the compensation agreements are not only concluded with the U.S.S.R. It has become customary that Western countries and their firms engage in joint ventures with COMECON countries on essentially the same basis of operations.

Non-communist and/or developing countries

The fourth area of influence are the non-communist and developing countries which display some type of a leaning and

affiliation towards the Soviet Union and her interests. The U.S.S.R. will always support very strongly government control over mineral resources and aid these countries in the same way the Western countries support the U.S.S.R. It will send out technicians and it will extend credit to those willing to develop mineral resources and keep their distribution under government control. It should be obvious that when the foundation of an economy is under that type of central control, all other levels of manufacturing are under some type of dependency. Any central government which exercises such monopoly control cannot fail to have detrimental effects on other, private firms. This has recently been observed by individual mining firms in Bolivia where the government corporation has the monopoly over smelting, with the result that the mining firms strongly complained about the excessive charges by the monopoly.

In 1979, this type of aid to develop the resources of developing and friendly countries of the U.S.S.R. exceeded one hundred programs in about sixty-four countries. The investment support by the U.S.S.R. amounted to 5 billion rubles, of which 1.0 billion were made available by a special fund of the COMECON International Investment Bank. Since most of this aid is directed towards resource development, the pay-back is tied to the delivery of raw materials. This means that the U.S.S.R. utilizes the technical expertise, technology and capital creating

resources of the industrialized countries in a very obvious way while drawing heavily also on the extensive raw material resources of the developing countries.

There is no question that this is the most concentrated effort in any country to harness capital and raw materials on a world-wide scale without endangering its own raw material base and by simultaneously force-feeding the industrialization of the U.S.S.R. At the same time, political conditions are influenced to suit the purposes of the U.S.S.R. without allowing any greater independence to its political friends in the economic field; and then, only if these concessions enhance the economic power and self-sufficiency of the U.S.S.R.

The United States of America

Industrial mineral policy in the United States is essentially operating under the conditions of the free marketplace according to the prescriptions of Dr. Adam Smith of 200 years ago. It is the forces of the marketplace which are at work and it is left to the ability and strength of the mineral-producing firms to supply industry with the much needed minerals. These firms will partake in the market game as long as a profit can be made. The industry will supply metals and minerals.

In this function, the chief criterion of existence of any firm is that the return over cost is greater than the interest

rate including a compensation for the severe risk encountered by the mining industry. No matter where in the world this profit can be obtained, the mining firms must avail themselves of the opportunities as they offer themselves. It is a question of investment survival. The firms will go anywhere on this globe, if their expertise is properly compensated, no matter who requests their services!

In the United States and in Canada, all companies must compete and they cannot combine to rig the market. The anti-trust cases of Aluminum of America, which had a monopoly in aluminum production, is as much a case in point as the recent uranium cartel. On this base, one has to realize that the mining firms are just partners in one of several industries regardless of their critical importance to the whole economy. Instead of enjoying the outright support of the authorities - as in other countries - they are in constant abeyance of the authorities. Neither the central tutelage by government as in the U.S.S.R., nor the coordinated cooperation so characteristic of the atmosphere surrounding the industry in Japan are current in the United States of America. The point is well recognized south of our border that something essential is missing: a general concerted central policy in support of mining. Yet, it is worse than that. Governments and numerous other authorities intervene in the questions of the industry. It is well known

that the industry is constantly under pressure of rising wages, interest costs and greater capital expenditures which have placed it into a squeeze. To this have been added pressures exerted by regulatory activities emanating from the broad sector of bureaucratic governments. It is the sum total of all these costs and their increases which have put the industry into its present deplorable position.

For instance, George B. Munroe, then Chairman of Phelps Dodge Corporation, warned against wage increases by drawing on the bad examples of plant closings in the steel industry.[3] At that time, there were a number of interesting copper deposits in Arizona and he expressed the opinion that they should move towards production: "assuming reasonable federal and state policies regarding taxation, environmental restraints and other regulatory matters,"[4] reasonable policies which he declared do not presently exist. In addition, the possible wholesale withdrawal of mining lands by the Forest Service and Bureau of Land Management, especially in Alaska, may hinder the mining companies from discovering and developing new ore bodies.[5]

No industry is more affected than that of lead production. Environmental regulations have had a twofold impact. In the first instance, a decline in consumption demand for lead has materialized as the anti-knock lead additives were recognized as constituting considerable health hazards to the public. The

demand for lead declined dramatically. However, this obvious consumer benefit has its cost in additional fuel requirements which will lead to future energy shortages. In the opinion of Mr. Howard E. Hesselberg, Vice-President, Air Conservation, of the Ethyl Corporation, as he said more than a year ago, the lead phasedown may lead to two billion gallons of gasoline per year used in addition to its present consumption.[6] A total phaseout of lead would require 38 billion barrels per year.

> "Looking back to the amount of crude oil that the use of lead antiknocks has conserved just since World War II, I think it is conservative to say that over 5.5 billion barrels have been saved in the U.S. alone which is about equal to the estimated total crude run of all U.S. refineries in 1980."[7]

The second point is that emission control regulations of the EPA have a tendency to force new smelters to be constructed outside the U.S.A. The U.S. mining industry is raising its views toward smelter construction in Mexico and Canada. The combined effect of these regulations explains the decline in the smelting and refinery capacity. As one man had it:

> "This does not mean that one has to be self-sufficient in anything but it is obvious that where one has more than adequate reserves in the ground the U.S.A. should not be importing material. This holds for lead, copper and zinc. The U.S. has a better reserve position than the rest of the world and we are importing material we have in abundance in this country. If that continues we'll see a withering away in the smelting industry."[8]

Mr. Adams added that "unlike virtually every other country in the world, the U.S.A. also has no policy on minerals and mining! Most countries have a strong stated policy to promote and develop their mining industries, but we do not."[9]

Copper, lead and zinc appear to be the obvious examples for metals imported by the U.S.A. in spite of the fact that these metals are in great abundance in that country. However, we should not forget that even uranium is on the import list. As was reported, the Rochester Gas and Electric Co. of the U.S.A. is to import $45 million worth of enriched uranium from the U.S.S.R., involving 94,600 lbs. over a five year period.[10]

These examples in no small way describe the mineral situation in the United States, the dilemma the mining industry finds itself in there and the contrast which its mineral policy stands towards those of the U.S.S.R. and Japan. Whether President Reagan and his administration will be able to put the U.S. mining industry on a new course remains to be seen; at least a new mineral policy is high on the list of priorities of his new administration,[11] not to mention the concern over the inadequacies of the national stockpile of strategic minerals.[12]

NOTES

1. See: Satoru Suda, "Japan", <u>Mining Annual Review 1980</u>, Mining Journal, London, pp. 482-485.

2. See: V.V. Strishkov, "Sovjet Union", <u>Mining Annual Review</u>, ibid. pp. 579-605, esp. pp. 579-589, where the basic statistical information is taken from.

3. <u>American Metal Market</u>, Vol. 88 No. 17, January 25, 1980, p. 7

4. Ibid.

5. Ibid.

6. "Lead Phasedown Blocks Gasoline Output". <u>American Metal Market</u>, Vol. 88, No. 16, January 24, 1980, p. 1, 20.

7. Ibid.

8. Attributed to Wright, "Regs Forcing Foreign Smelter Sites", <u>American Metal Market</u>, Vol. 88, No. 17, January 25, 1980.

9. Ibid.

10. V.V. Strishkov, loc. cit., p. 589.

11. "Reagan stance seen as broadly pro-mining and pro-development", <u>Engineering and Mining Journal</u>, December, 1980, p.15.

12. "Strategic minerals outlook shakes U.S. defense establishment", <u>Engineering and Mining Journal</u>, February, 1981, p.13.

NOTES

1. See: Satoru Suda, "Japan" Mining Annual Review 1980, Mining Journal, London, pp. [illegible].

2. See: V.V. Strishkov, "Soviet Union", Mining Annual Review, ibid, pp. [illegible], esp. pp. [illegible], where the basic [illegible] information is taken from.

3. American Metal Market, Vol. 88, No. 17, January 25, 1980, p. [illegible]

4. Ibid.

5. Ibid.

6. "Lead Shortage Might Restrain Output", American Metal Market, Vol. 88, No. 16, January 24, 1980, p. 1, 20.

7. Ibid.

8. [illegible], American Metal Market, [illegible], January 25, 1980.

9. Ibid.

10. V.V. Strishkov, loc. cit., p. [illegible].

11. "[illegible] development", Engineering and Mining Journal, December, 1980, p.15.

12. "[illegible]", Engineering and Mining Journal, February, 1981, p.[illegible].